



DOCUMENT 161-00

DATA REDUCTION AND COMPUTER GROUP

**IRIG DATA FORMATS
FOR
INTERRANGE TRANSMISSION OF TRACKING DATA
FROM
COMPUTER TO COMPUTER
(EFG, RAE, AND XYZ FORMATS)**

**WHITE SANDS MISSILE RANGE
KWAJALEIN MISSILE RANGE
YUMA PROVING GROUND
DUGWAY PROVING GROUND
ABERDEEN TEST CENTER
NATIONAL TRAINING CENTER
ATLANTIC FLEET WEAPONS TRAINING FACILITY
NAVAL AIR WARFARE CENTER WEAPONS DIVISION
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION, NEWPORT
PACIFIC MISSILE RANGE FACILITY
NAVAL UNDERSEA WARFARE CENTER DIVISION, KEYPORT
30TH SPACE WING
45TH SPACE WING
AIR FORCE FLIGHT TEST CENTER
AIR ARMAMENT CENTER
AIR WARFARE CENTER
ARNOLD ENGINEERING DEVELOPMENT CENTER
GOLDWATER RANGE
UTAH TEST AND TRAINING RANGE
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MARCH 2000

Prepared by

**DATA REDUCTION AND COMPUTER GROUP
RANGE COMMANDERS COUNCIL**

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ACRONYMS AND INITIALISMS

30 SW	30 th Space Wing, Vandenberg AFB, CA
45 SW	45 th Space Wing, Patrick AFB, FL
A	angle
AAC	Air Armament Center, Eglin AFB, FL
A/B	auto beacon
AFDTC	Air Force Development Test Center, Eglin AFB, FL
AFFTC	Air Force Flight Test Center, Edwards AFB, CA
AO	azimuth override
A/S	auto skin
AT	auto track
AWC	Air Warfare Center, Tyndall AFB, FL
AZ	azimuth angle
BAMS	binary angular measurement system
BCD	binary coded decimal
BPS	bits per second
BS	skin/beacon mode
CD	computer drive mode
CRC	cyclic redundancy code
CT	coherent tract
dB	decibel
DD	destruct Doppler
DI	droop
DP	Doppler
DQ	data quality
EFG	E-axis, F-axis, G-axis
EL	elevation
EO	elevation override
EPG	Electronic Proving Ground, Ft. Haachuca, AZ
ER	Eastern Range
ETR	Eastern Test Range
GMT	Greenwich Mean Time
GRDCS	gulf range drone control system
ICC	Instrumentation Control Center
ID	identification
IRIG	Interrange Instrumentation Group
Kaena Pt	Kaena Point, Oahu, HI
kbps	kilobar per second
KMR	Kwajalein Missile Range, Kwajalein Atoll, Pacific Ocean
L	liftoff
LFI	last frame indicator
LO	liftoff

LSB	least significant bit
MIPIR	missile precision instrumentation radar
M/S	manual/skin mode
MSB	most significant bit
msec	millisecond
NASA	National Aeronautics and Space Administration
NAWCAD	Naval Air Warfare Center Aircraft Division, Pax River, MD
NAWCcl	Naval Air Warfare Center, China Lake, CA
NAWCpm	Naval Air Warfare Center, Point Mugu, CA
NAWCpr	Naval Air Warfare Center, Pax River, MD
NAWCWD(cl or pm)	Naval Air Warfare Center Weapons Division, China Lake, CA; or Point Mugu, CA
NU	not used
OA	on-axis mode
OPT	optical track
OT	optical track; on track; on target
OTC	on-track mode
P	plunge mode; paramp
P/A	passive/active
PL	plunge mode
PMRF	Pacific Missile Range Facility, Kauai, HI
PO	paramp
pps	pulses per second
PS	position scale
PT	plus time
PW	pulse width
Q	quality
R	radiation; range
RA	radiation
RAE	range, azimuth, elevation
REF	refraction
RF	refraction
RF	RF limit
RI	refraction
RO	radiation
R/T	real test
SB	skin beacon; skin track/ beacon track
SCP	position data scale
SCV	velocity data scale
SD	star data
sec	second
SIC	satellite ID code
SL	single
SS	sensor switch

sync	synchronization
T	track; transit
TOD	time of day
TR	on-track; track mode
TSPI	time space position information
usec	microsecond
UTC	universal time coordinated
UTTR	Utah Test and Training Range, Hill AFB, UT
V0, V1, V2	vehicle number
VD	valid data
VS	velocity scale
WR	Western Range
WSMR	White Sands Missile Range, White Sands, NM
XYZ	x-axis, y-axis, z-axis
yd	yard

PURPOSE

This document is a compilation of the responses to the Interrange Tracking Data Transmission Questionnaire sent to the ranges listed in figure 1. The questionnaire requested that each range check their compliance with IRIG Standard 161-85, IRIG Standard Data Format for Interrange Transmission of Tracking Data from Computer to Computer (2400 BPS Synchronous EFG Format 0). Currently, there are a total of 9 formats and 11 format subdivisions for interranger transmission of real-time tracking data from a computer on one range to a computer on another range. Figure 1 is a matrix of the formats and format users (i.e., ranges) which illustrates range-to-range real-time time space position information (TSPI) data links.

APPLICATIONS

The formats defined in this document are used by the national and service ranges for interchange of data. The classification of the formats is based on the degree of difference between the standard Format 0 and each format received from the ranges in response to the questionnaire. These dissimilarities consist of bit coding variations as well as characteristic variations among the formats. Also, the nomenclature of the formats does not necessarily represent their technical reference identification when used by their respective range.

LIMITATIONS

The formats, with the exception of Formats 7 and 9, consist of 8 words, each containing 30 bits, for a total of 240 bits per frame. The frame rate is 10 frames per second. The formats have different coordinate systems; i.e., EFG geocentric, XYZ tangent plane, and RAE polar. Therefore, in order to accomplish a successful communication between ranges, some conventions must be observed.

COORDINATE SYSTEM DEFINITIONS

EFG

Geocentric Coordinate System. Orientation of system axis is system origin is at the geocenter, positive E-axis extends from origin through Greenwich meridian at the equator, positive F-axis extends from origin through 90-degree E meridian at the equator, and positive G-axis extends from origin through the North Pole.

XYZ

Rectangular Coordinate System. It is topocentric and Earth-fixed. Orientation of system axis is positive x-axis extends from origin to East, positive y-axis extends from origin to North, and positive z-axis extends from origin going up.

RAE

Polar Coordinate System. It is topocentric and Earth-fixed. Orientation of system axis is azimuth zero is true North with units increasing in a clockwise direction, elevation is horizontal with units increasing in an upward direction, and range zero is at the origin with increasing range away from the origin.

Matrix of Formats and Format Users

To From	30 SW Vandenberg	45 SW Patrick	AAC Eglin	AFTTC Edwards	AWC Tyndall	EPG Aviano	Kaena Pt Oahu, HI	KMR Kwajalein	NASA	NAWCAD Pac River	NAWCWDpm Point Mugu	PMRF Kauai, HI	UTTR Utah	WSMR New Mexico
30 SW	1A	1A/2B		1A			1A/2B		0C		1A			
45 SW	1A/2B	1C				0A			9			2A		0A
AAC														
AFTTC	1B	1B							4		1B		4	
AWC			7											
EPG									3					5/6
Kaena Pt	1A/2B							2B						
KMR							0B/2B	0/0B	0B			0/0B/2B		
NASA	0C	8/9		4								0C		
NAWCAD														
NAWCWD				4										
NAWCWDpm	1/1A			1										
PMRF	2C	2					2C	0/2C	0C			2C		
UTTR				4										
WSMR		3/3A				5/6								

Figure 1. Range to Range Real-Time TSPI Data Links.

30 SW 30th Space Wing, Vandenberg AFB, CA
 45 SW 45th Space Wing, Patrick AFB, FL
 AAC Air Armament Center, Eglin AFB, FL
 AFTTC Air Force Flight Test Center, Edwards AFB, CA
 AWC Air Warfare Center, Tyndall AFB, FL
 EPG Electronic Proving Ground, Ft. Huachuca, AZ
 Kaena Pt. Kaena Point, Oahu, HI
 KMR Kwajalein Missile Range, Kwajalein Atoll, Pacific Ocean
 NASA National Aeronautics and Space Administration
 NAWCAD Naval Air Warfare Center Aircraft Division, Pax River, MD
 NAWCWD(pm or cl) Naval Air Warfare Center Weapons Division, Point Mugu, CA; and China Lake, CA
 PMRF Pacific Missile Range Facility, Kauai, HI
 UTTR Utah Test and Training Range, Hill AFB, UT
 WSMR White Sands Missile Range, White Sands, NM

FORMAT DEFINITIONS AND FIGURES

Format 0 IRIG 240-Bit Format (EFG)

This format is used for transmitting and receiving tracking data between PMRF and KMR, and internally within KMR (see figure 2).

Word 1		
Bits 1-16	Test Number, LSB = Bit 1	This field will handle a test number up to 65535.
Bits 17-25	Day of Year	This field is used to identify the day of the year.
Bits 26-30	Format Type: 00000	
Word 2		
Bits 31-34	Tenth of Second, MSB = Bit 34 = 800 msec	
Bits 35-51	Time of Day or Plus Time, LSB = Bit 35 = 1 sec	This field tags the data in seconds and may be either time or plus time according to bit-to-bit 150.
Bits 52-60	Site ID	These 9 bits provide the Site ID.
Word 3		
Bits 61-88	E-Pos., LSB = Bit 61	Value of E in meters. Bit 88 indicates the sign of E.
Bits 89-90	Position Scale Factor (KMR always sends 00)	00 = 1 110 = 10^{**3} 01 = 10 11 = 10^{**10}
Word 4	(KMR max absolute value of F is $(2^{**27}) - 1$)	
Bits 91-118	F-Pos., LSB = Bit 91	Value of F in meters. Bit 118 indicates the sign of F.
Bits 119-120	Velocity Scale Factor	00 = 1 01 = 10
Word 5	(KMR max absolute value of G is $(2^{**27}) - 1$)	
Bits 121-148	G-Pos., LSB = Bit 121	Value of G in meters. Bit 148 indicates the sign of G.
Bits 149	Optical Track (KMR always sends 0)	1 = on-track
Bit 150	Plus Time Flag (KMR always sends 0)	1 = if plus time rather than Zulu time
Word 6		
Bits 151-165	F-Velocity (meters per second), LSB = Bit 151	Bit 165 indicates its sign.
Bits 166-180	E-Velocity (meters per second), LSB = Bit 166	Bit 180 indicates its sign.

Word 7

Bit 181	Liftoff (KMR always sends 1) 1 = liftoff has occurred
Bit 182	Plunge Mode (KMR always sends 0) 1 = plunge
Bits 183-184	Pulse Width (KMR always sends 0) 0-1.0 usec 1-2.4 usec 2-5 usec 3-10 usec
Bit 185	Refraction (KMR always sends 1) 1 = in 0 = out
Bit 186	RF Limit (KMR always sends 0) 1 = in 0 = out
Bit 187	Paramp (KMR always sends 0) 1 = on 0 = off
Bit 188	Radiation (KMR always sends 1) 1 = on 0 = off
Bit 189	Single (KMR always sends 0) 1 = dual lo 0 = single lo
Bit 190	Skin/Beacon Mode 1 = beacon 0 = skin
Bit 191	Track Bit 1 = on 0 = off
Bit 192	Quality Bit 1 = good 0 = bad
Bit 193-195	Mode (KMR always sends 7 = active track; 1 = all others) 0 = manual 4 = on-axis powered flight 1 = auto track 5 = on-axis coast 2 = computer drive 6 = auto track coast 3 = on-axis orbital
Bits 196-210	G-Velocity (in meters per second), LSB = Bit 196 Bit 210 indicates its sign.

Word 8

Bits 211-218	Check Sum
Bits 219-224	Spares Can be used for the target signal-to-noise level, 0 to 63 dB (LSB = 1 dB = Bit 219)
Bits 225-240	Sync Bits 0001101000011010: This pattern occurs on one message. 0001101000000101: This pattern occurs on next.

Check Sum Calculation

1. The first 210 data bits are treated as 14 words of 15 bits each. These words are summed (treating them as positive integers) in an accumulator capable of handling a 19-bit positive integer sum.
2. This sum is split into three parts; the most significant 7 bits, the next most significant 6 bits, and the least significant 6 bits. Three words are summed (treating them as positive integers) in an accumulator capable of handling an 8-bit positive integer sum.
3. This sum becomes the check sum.

NOTE

All fields are binary except where noted. Sign convention is two's complement. Day of Year, Test Number, and Check Sum may either be valid or zero.

Object/Test Number																Day of Year										Format Type					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Tenth				Time of Day (Seconds)																		Site ID									
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60		
E																												PS			
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90		
F																												VS			
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120		
G																												OT	PT		
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150		
F-Velocity (Meters/Sec)																E-Velocity (Meters/Sec)															
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180		
L	P	P/W	RI	RF	P	RA	S L	B S	T	Q	Mode				G-Velocity (Meters/Sec)																
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210		
Check Sum								Spares								Sync Bits															
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240		

Figure 2. IRIG 240-Bit (KMR, PMRF, and ARGUS Aircraft Data) Format 0.

Format 0A
IRIG 240-Bit Format (EFG)

This format is used for transmitting from 45 SW to WSMR, EPG (Ft. Hauchuca), Bermuda, Wallops Island, and Korou (see figure 3). This format is the same as Format 0 except for the following:

Word 1

- Bits 1-17 Object/Test Number, LSB = Bit 1
This field is now composed of 17 bits.
- Bits 18-26 Day of Year, LSB = Bit 18
This field is reduced to 9 bits.
- Bits 27-30 Format Type, LSB = Bit 27
This field is reduced to 4 bits.

Word 8

- Bits 211-217 Check Sum
This field is reduced to 7 bits.
- Bits 218-224 Spares
This field is now composed of 7 bits.

Object/Test Number																	Day of Year										Format Type		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Tenth				Time of Day (Seconds)																		Site ID							
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
E																											PS		
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
F																											VS		
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
G																											OT		PT
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
F															E														
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
L	P	P/W	RI	RF	P	RA	S L	B S	T	Q	Mode				G														
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
Check Sum							Spares							Sync Bits															
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Figure 3. IRIG 240-Bit (ETR) Format 0A.

Format 0B
IRIG 240-Bit Format (EFG)

This format is used for transmission only of tracking data from KMR to NASA, PMRF, and Kaena Point. It is also used to transmit internally within KMR (see figure 4). Format 0B is the same as Format 0 except for the following:

Word 1
 Bits 1-3 Objective Code
 Bits 4-16 Spare
 Word 2
 Bits 31-34 Tenth is not used

Obj Code			Spare														Day of Year										Format Type					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
Tenth			Time of Day (Seconds)																		Site ID											
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60			
E																													PS			
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90			
F																													VS			
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120			
G																													OT	PT		
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150			
F-Velocity (Meters/Sec)															E-Velocity (Meters/Sec)																	
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180			
L	P	P/W	RI	RF	P	RA	S L	B S	T	Q	Mode	G-Velocity (Meters/Sec)																				
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210			
Check Sum								Spares								Sync Bits																
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240			

Figure 4. IRIG 240-Bit (ETR) Format 0B.

Format 0C
IRIG 240-Bit Format (EFG)

This format is used for transmitting and receiving data between PMRF and NASA, and between 30 SW and NASA Goddard (see figure 5). This format is the same as Format 0 except for the following:

Word 1

Bits 1-13 Satellite ID Code
Bits 14-17 Vehicle ID

Word 2

Bits 31-34 Tenth is not used

Satellite ID Code														Veh ID				Day of Year						Format Type						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Tenth				Time of Day (Seconds)																		Site ID								
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
E																													PS	
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	
F																													VS	
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	
G																													OT	PT
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	
F-Velocity (Meters/Sec)														E-Velocity (Meters/Sec)																
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	
L	P	P/W	RI	RF	P	RA	S L	B S	T	Q	Mode		G-Velocity (Meters/Sec)																	
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	
Check Sum								Spares								Sync Bits														
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	

Figure 5. IRIG 240-Bit (NASA LTAS) Format 0C.

Format 1
IRIG 240-Bit Format (RAE)

This format is used for the transmission of time space position information (TSPI) and acquisition data from NAWCWD (Point Mugu) to 30 SW, and AFFTC (see figure 6).

Word 1	
Bits 1-9	CRC Error Check (cyclic redundancy code) This field is the error detection for the previous frame (binary).
Bit 10-16	Frame Sync Synchronization code is complemented every other frame. Master sync. has the bit pattern 1110010. It is maintained at 1 pps.
Bits 17-23	Site ID, LSB = Bit 17 These 7 bits provide the Site ID.
Bit 24	On Track 1 = on track 0 = off
Bit 25	0
Bit 26	Skin/Beacon 1 = skin track 0 = beacon track
Bit 27	0
Bits 28-29	(Classification) Spare For messages transmitted from NAWCWD (Point Mugu) Bit 28 = 1: Confidential; Bit 29 = 1: Secret
Bit 30	0
Word 2	
Bits 31-55	Range, LSB = Bit 31 Its value per bit varies from radar to radar (yards)
Bits 56-60	Azimuth Angle, MSB = Bit 74 MSB = 180 degrees. Each descending order bit is equal to one half the value of the previous bit. Lower order bits are zeroed depending on the resolution of the angle.
Word 3	
Bits 61-74	Azimuth (continuation)
Bits 75-90	Elevation Angle, MSB = Bit 93 MSB = 180 degrees. Each descending order bit is equal to one half of the previous bit.
Word 4	
Bits 91-93	Elevation (continuation)
Bits 94-114	Range Rate, LSB = Bit 94 Twenty-one bits of Doppler format (yards/sec)
Bits 115-120	Expansion (options)

Word 5

Bits 121-123 Events
 Bits 124-129 Time Vernier, MSB = Bit 129
 MSB = 800 msec
 Bits 130-133 Auxiliary Data
 Bits 134-150 Time of Day, LSB = Bit 134
 LSB = 1 sec

Words 6, 7, and 8 (Bits 151-240) are the same as Words 2, 3, and 4 (Bits 31-120), respectively.

CRC Error Check									Frame Sync							Site ID						OT	0	SB	0	Class	0		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Range (Yards)																								AZ					
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Azimuth (cont.)														Elevation															
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
EL		Range Rate (Yards/Sec)																						Expansion					
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Event		Time Vernier						Auxiliary				Time																	
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
Range																								AZ					
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Azimuth														Elevation															
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
EL		Range Rate																						Expansion					
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Figure 6. IRIG 240-Bit (NAWCWD Point Mugu) Format 1.

Format 1A
IRIG 240-Bit Format (RAE)

This format is used for the transmission of data from 30 SW to AFFTC, and for transmitting and receiving data between NAWCWD (Point Mugu) and 30 SW, between 30 SW and 45 SW, and between 30 SW and Kaena Point. It is also used to transmit internally within 30 SW (see figure 7).

Word 1

Bits 1-9	CRC Error Check	
Bits 10-16	Frame Sync	
Bits 17-23	Site ID	
Bit 24(OT)	1 = sensor on target	0 = sensor not on target
Bit 25 (CT)	1 = coherent track	0 = not coherent track
Bit 26 (SB)	1 = skin track	0 = beacon track
Bit 27 (DQ)	1 = MIPIR good data quality	0 = no good quality
Bit 28 (RF)	Refraction Correction Indicator	
Bit 29 (T)	1 = transit correct	
Bit 30 (SP)	unused	

Word 2

Bits 31-55	Range: LSB = 1.953125 yds, LSB = Bit 31
Bits 56-60	Azimuth: MSB = 180 degrees, MSB = Bit 74

Word 3

Bits 61-74	Azimuth (cont.)
Bits 75-90	Elevation: MSB = 180 degrees, MSB = Bit 93

Word 4

Bits 91-93	Elevation (cont.)
Bits 94-114	Range Rate
	Bit 94: LSB = 0.03125 yd/sec
	Bit 113: MSB = 1384 yd/sec
	Bit 114: Sign 1 = decreasing range 0 = increasing
Bits 115-117	Range Expansion (3 bits)
	Bit 115: LSB = 0.244140625 yds
Bits 118-120	Range Rate Expansion
	Bit 118: LSB = 0.00390625 yd/sec

Word 5

Bits 121-122	Time Events (2 bits)
	Bit 121: 1 = liftoff
	Bit 122: 1 = sensor switch
Bits 123-129	Sample Time Vernier (7 bits)
	Binary counter of fractions of seconds since last second.
	Bit 123: LSB = 12.5 millisecs
	Bit 129: MSB = 800 millisecs

Bits 130-133 Auxiliary bits
 Unused but reserved

Bits 134-150 Sample Time
 Binary count of seconds universal time coordinated (UTC)
 Bit 134: LSB = 1 sec
 Bit 150: MSB = 65536 secs

Words 6, 7, and 8 (Bits 151 to 240) are the same as Words 2, 3, and 4 (Bits 31 to 120), respectively.

NOTE

The values for these bit weights are nominal for the 30 SW radar. Some radars from NAWCWD (Point Mugu) have different nominal values. Radars operating and transmitting 10-pps data shall have the respective data the same for 30 SW line Bits 31-114 and Bits 151-234. Radars operating and transmitting 20-pps data shall have Bits 31-114 associated with the Time Vernier, and data contained in 30 SW line Bits 151-234 shall be 50 milliseconds later.

CRC Error Check										Frame Sync							Site ID							OT	CT	SB	DQ	RF	T	SP
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Range (Yards)																								AZ						
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
Azimuth (cont.)															Elevation															
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	
EL		Range Rate (Yards/Sec)																						Range			R. Rate			
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	
Evt.		Time Vernier							Auxiliary					Time																
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	
Range																								AZ						
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	
Azimuth															Elevation															
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	
EL		Range Rate																						Range			R. Rate			
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	

Figure 7. IRIG 240-Bit (SW 30) Format 1A.

Format 1B
IRIG 240-Bit Format (RAE)

This format is used for the transmission of data from AFFTC to NAWCWD (Point Mugu), 30 SW, and 45 SW (see figure 8). This format is the same as Format 1 except for the following:

Word 1

Bit 25 (CT)	1 = coherent track	0 = not coherent track
Bit 28 (OPT)	1 = optical track	0 = not optical track
Bit 29 (AO)	1 = azimuth override	0 = off
Bit 30 (EO)	1 = elevation override	0 = off

Word 4

Bits 115-117	Range
Bits 118-120	Range Rate

Word 5

Bits 121-122	Event
Bit 121 (LO):	1 = liftoff 0 = stand-by
Bit 122 (SS):	1 = sensor switch 0 = off

NOTE

Bits 27, 56, 57, 75, 76, 123, 176, 177, 195, 196 are not used (NU).

CRC Error Check										Frame Sync						Site ID						OT	CT	SB	N U	OPT	AO	EO	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Range (Yards)																										NU	NU	AZ	
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Azimuth															NU	NU	Elevation												
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
EL		Range Rate (Yards/Sec)																						Range			R. Rate		
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
LO	SS	NU	Time Vernier					Auxiliary					Time																
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
Range																										NU	NU	AZ	
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Azimuth															NU	NU	Elevation												
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
EL		Range Rate																						Expansion					
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Figure 8. IRIG 240-Bit (RAE) Format 1B.

Format 1C
IRIG 240-Bit Format (RAE)

This format is used for transmitting and receiving shuttle landing data at 45 SW (see figure 9). Format 1C is the same as Format 1 except for the following:

Word 1

Bit 25 (CT) 1 = coherent track 0 = not coherent
Bit 27-30 Spare

Word 5

Bit 130-132 Objective Number
Bit 133 (NU) Not Used

CRC Error Check										Frame Sync							Site ID						OT	CT	SB	Spare					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Range (Yards)																										AZ					
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60		
Azimuth															Elevation																
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90		
EL		Range Rate (Yards/Sec)																								Expansion					
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120		
Event		Time Vernier								Obj #		NU	Time																		
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150		
Range																										AZ					
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180		
Azimuth															Elevation																
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210		
EL		Range Rate																								Expansion					
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240		

Figure 9. IRIG 240-Bit (Western Range) Format 1C.

Format 2
IRIG 240-Bit Format (EFG)

This format is used for the transmission of radar and acquisition data from PMRF to 45 SW (see figure 10). Format 2 is the same as Format 2C with the exception of the bit numbering.

Word 1	
Bits 1-9	CRC Error Checking Cyclic redundancy code used for error detection
Bits 10-16	Frame Sync Seven bits on main synchronization code which complement every other frame. The master code is 1110010.
Bit 17 (P/A)	Passive/Active Flag 1 = active 0 = passive
Bit 18 (ST)	Not used
Bit 19 (OA)	On-Axis Mode
Bit 20 (TR)	On-Track Mode
Bit 21 (CD)	Computer Drive Mode
Bit 22 (SD)	Star Data Flag 1 = Star data 0 = Normal data
Bits 23-25	Vehicle Number (V0, V1, V2)
Bits 26-30	Sub Sync Complemented every other frame with a master code of 11010 in binary.
Word 2	
Bits 31-60	E-axis: 30 bits of x-geodetic position. Two's complement negative number. LSB weighting depends on SCP bits (feet). LSB = Bit 31
Word 3	
Bits 61-90	F-axis: 30 bits of y-geodetic position. Two's complement negative number. LSB weighting depends on SCP bits (feet). LSB = Bit 61
Word 4	
Bits 91-120	G-axis: 30 bits of z-geodetic position. Two's complement negative number. LSB weighting depends on SCP bits (feet). LSB = Bit 91
Word 5	
Bits 121-130	Time Vernier LSB = 1 milliseconds = Bit 121
Bits 131-147	Time Seventeen bits of GMT time LSB = 1 second = Bit 131
Bit 148	Not Used
Bit 149 (SB)	1 = beacon mode 0 = skin mode
Bit 150 (VD)	1 = valid data 0 = not valid

Word 6

Bits 151-166	E-Velocity Sixteen bits of x-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Fractional velocity field appended to velocity field before LSB weighting factor applied (feet/sec). LSB = Bit 151
Bits 167-168 (SCV)	Velocity Data Scale 00 = LSB of 1 feet/sec 10 = Not used 01 = LSB of 10 feet/sec 11 = Not used
Bits 169-170 (SCP)	Position Data Scale 00 = LSB of 1 feet/sec 10 = LSB of 1000 feet/sec 01 = LSB of 10 feet/sec 11 = LSB of 10**20 feet/sec
Bits 171-180	BCD Day of Year, LSB = Bit 171 The day of the year as 3 binary coded decimal digits.

Word 7

Bits 181-196	F-Velocity, LSB = Bit 181 Sixteen bits of y-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Fractional velocity field appended to velocity field before LSB weighting factor applied (feet/sec).
Bits 197-204	Site ID, LSB = Bit 197 The site identification of the data source. The FPQ-14 has a Site ID of 11100110 in binary. Any other site is ignored by real-time software. On data going to the FPQ-14, the PMRF BCD Site ID shall be used.
Bits 205-206	Spares: Not used, not reserved.
Bits 207-210	Fractional E-Velocity, LSB = Bit 207 Four bits of fractional x-velocity. LSB weighting depends on SCV bits. Appended to velocity before scale applied. This field reflects the sign convention control for the velocity field.

Word 8

Bits 211-226	G-Velocity, LSB = Bit 211 Sixteen bits of z-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Fractional velocity field appended to velocity field before LSB weighting factor applied.
Bits 227-232	1000 (1-B) FPQ-14 filter coefficient. 000000 = Perfect data. LSB = Bit 227
Bits 233-236	Fractional G-Velocity, LSB = Bit 233 Four bits of fractional z-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Appended to velocity data before scale factor applied. This field reflects the sign convention and control for the velocity field.

Bits 237-240

Fractional F-Velocity, LSB = Bit 237

Four bits of fractional y-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Appended to velocity data before scale factor applied. This field reflects the sign convention and control for the velocity field.

NOTE

The on-track condition is determined by the following logic:

VD = 1 .And. R = 1 .Or. QA = 1

CRC Error Check									Frame Sync							PA	ST	QA	TR	CD	SD	V0	V1	V2	Sub Sync						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
E (Feet)																															
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60		
F (Feet)																															
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90		
G (Feet)																															
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120		
Time Vernier									Time																				NU	SB	VD
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150		
E-Vel (Feet/Sec)																SCV		SCP		BCD Day of Year											
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180		
F-Vel (Feet/Sec)																Site ID										Spare		Fract E-Vel			
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210		
G-Vel (Feet/Sec)																1000 (1-B)						Fract G-Vel				Fract F-Vel					
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240		

Figure 10. IRIG 240-Bit (PMRF) Format 2.

Format 2A
IRIG 240-Bit Format (EFG)

This format is used for the transmission of shuttle and special space test data from 45 SW to PMRF (Kauai) (see figure 11). Format 2A is the same as Format 2 except for the following:

Word 1

Bit 18	Spare (NU – not used)
Bit 20 (AT)	1 = Auto Track
Bits 26-30	Spare (Sub Sync is not used)

CRC Error Check										Frame Sync						PA	NU	OA	AT	CD	SD	V0	V1	V2	Sub Sync					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
E (Feet)																														
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
F (Feet)																														
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	
G (Feet)																														
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	
Time Vernier										Time																		NU	SB	VD
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	
E-Vel (Feet/Sec)																SCV		SCP		BCD Day of Year										
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	
F-Vel (Feet/Sec)																Site ID						Spare		Fract E-Vel						
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	
G-Vel (Feet/Sec)																1000 (1-B)						Fract G-Vel				Fract F-Vel				
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	

Figure 11. IRIG 240-Bit (Western Range) Format 2A.

Format 2B
IRIG 240-Bit Format (EFG)

Format 2B is used for transmitting and receiving radar and acquisition data between KMR and Kaena Point. It is also used for transmission from KMR to PMRF, and for post transmission and receipt of data between 30 SW and Kaena Point, and between 45 SW and 30 SW (see figure 12). Format 2B is the same as Format 2 except for the following:

Word 1

Bit 18 (DQ)	1 = good data quality
Bit 20 (AT)	1 = auto track
Bit 227-232	Spare

CRC Error Check									Frame Sync							PA	DQ	OA	AT	CD	SD	V0	V1	V2	Sub Sync					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
E (Feet)																														
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
F (Feet)																														
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	
G (Feet)																														
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	
Time Vernier									Time																			NU	SB	VD
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	
E-Vel (Feet/Sec)																SCV		SCP		BCD Day of Year										
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	
F-Vel (Feet/Sec)																Site ID										Spare		Fract E-Vel		
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	
G-Vel (Feet/Sec)																Spare						Fract G-Vel				Fract F-Vel				
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	

Figure 12. IRIG 240-Bit (Western Range) Format 2B.

Format 2C
IRIG 240-Bit Tracking Data for PMRF and KMR

This format is used by PMRF to transmit acquisition and metric tracking data to the Kaena Point FPQ-14 radar, the Air Force Kaena Point Satellite Tracking Facility, the Sandia Kauai Test Facility of PMRF, KMR, and 30 SW (see figure 13). Format 2C is the same as Format 2 with the exception of the bit numbering.

Word 1		
Bits 1-7	Frame Sync; 1110010 complemented every other frame	
Bit 8	P/A; Passive/Active is 0 filled and not applicable for this application	
Bit 9	ST; only applicable for KMR	
Bit 10	OA; On-Axis Mode, not applicable for this application	
Bit 11	TR; Track Mode, only applicable for KMR	
Bit 12	CD; Computer Drive Mode, not applicable for this application	
Bit 13	SD; Star Data, not applicable for this application	
Bits 14-16	Vehicle body number	
Bits 17-21	Sub Sync; 11010 complemented every other frame	
Word 2		
Bits 22-51	E; E-Geocentric Position, two's complement negative, LSB = Bit 22	
Word 3		
Bits 52-81	F; F-Geocentric Position, two's complement negative, LSB = Bit 52	
Word 4		
Bits 82-111	G; G-Geocentric Position, two's complement negative, LSB = Bit 82	
Word 5		
Bits 112-138	UTC Time of Day in Seconds; Bits 112-121 in milliseconds, Bits 122-138 in seconds, LSB = Bit 112	
Bit 139	Spare	
Bit 140	SB; Skin Beacon	
Bit 141	VD; Valid Data	
Word 6		
Bits 142-157	E-Velocity; feet/second, two's complement negative, LSB = Bit 142	
Bits 158-159	SCV; Scale factors for velocity	
	00 - LSB is 1 ft/sec	
	01 - LSB is 10 ft/sec	
	10 - not used	
	11 - not used	

Bits 160-161	SCP; Scale factors for position 00 - LSB is 1 ft 01 - LSB is 10 ft 10 - LSB is 10**3 ft 11 - LSB is 10**20 ft
Bits 162-171	BCD Day of Year, LSB = Bit 162
Word 7	
Bits 172-187	F-Velocity; feet/second, two's complement negative, LSB = Bit 172
Bits 188-195	Site ID
Bits 196-197	Spare
Bits 198-201	Fractional E-Velocity; two's complement negative, LSB = Bit 198
Word 8	
Bits 202-217	G-Velocity; feet/second, two's complement negative, LSB = Bit 202
Bits 218-223	1000(1-B); Filter Coefficient, not applicable, LSB = Bit 218
Bits 224-227	Fractional G-Velocity; two's complement negative, LSB = Bit 224
Bits 228-231	Fractional F-Velocity; two's complement negative, LSB = Bit 228
Bits 232-240	CRC Error Check; $x^{**9}+x^{**5}+1$

Frame Sync							PA	ST	OA	TR	CD	SD	Vehicle				Sub Sync					E-Position									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
E- Pos. (Feet)																					F-Position										
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60		
F-Pos. (Feet)																					G-Position										
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90		
G-Pos. (Feet)																					Milliseconds										
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120		
UTC Time of Day in Seconds																	0	SB	VD	E-Velocity											
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150		
Feet/Second							SVC		SCP		BCD Day of Year										F-Velocity										
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180		
Feet/Second							Site ID								0	0	Fract E				G-Velocity (Feet/Sec)										
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210		
G-Vel (feet/sec)							1000 (1-B)						Fract G				Fract F				CRC Error Check										
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240		

Figure 13. IRIG 240-Bit (PMRF Format Tracking Data, and KMR) Format 2C.

Format 3
IRIG 240-Bit Two-Radar Format (RAE or EFG)

This format is used for the transmission of shuttle data from EPG (Fort Huachuca, AZ) to NASA, and from WSMR to 45 SW (see figure 14).

Word 1	
Bits 1-4	Tenth
Bits 5-21	Time of Day (binary) first radar, LSB = Bit 5 = 1 sec
Bits 22-30	Azimuth
	Seventeen bits of azimuth binary data first radar. LSB (Bit 24) is 0.0027465 degrees for all radars. MSB (Bit 40) is 180 degrees.
Word 2	
Bits 31-40	Azimuth (cont.)
Bits 41-59	Elevation
	Seventeen bits of elevation binary data first radar. Bit weighting is the same as for azimuth. MSB = Bit 59
Bits 60 (B/S)	Beacon/Skin mode first radar
	1 = beacon mode 0 = skin mode
Word 3	
Bits 61-85	Range
	Twenty-four bits of range binary data first radar. LSB (Bit 61) is 1 yard for all radars.
Bit 86 (OT)	Track bit first radar
	1 = on-track
Bit 87 (Q)	Quality bit first radar
Bit 88-90	Radar Site ID, first radar, LSB = Bit 88
Word 4	
Bits 91-96	Radar Site ID (cont.)
Bits 97-104	WSMR Sync Code - 00010101
Bits 105-113	Day of the Year - not used
Bits 114-117	Format Type = 1101 assigned for two-radar format
Bits 118-120	Spare
Word 5	The fields of Word 5 (Bits 121-150) are the same as for Word 1. Second radar data.
Word 6	The fields of Word 6 (Bits 151-180) are the same as for Word 2. Second radar data.
Word 7	The fields of Word 7 (Bits 181-210) are the same as for Word 3. Second radar data.
Word 8	
Bits 211-216	Site ID Second Radar (cont.)
Bits 217-224	WSMR Sync Code - 00001010
Bits 225-240	Sync Code
	Alternate between the following patterns: 0101100001011000 on one frame and 1010000001011000 on the next.

Tenth				Time 1 st Radar (Seconds)																	Azimuth									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
AZ Cont. 1 st (Radar)										Elevation 1 st Radar																				BS
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
Range (Yards)																										OT	Q	Site ID		
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	
Site 1 st Radar					WSMR Sync										Day of Year										Format Type				Spare	
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	
Tenth				Time 2 nd Radar (Seconds)																	Azimuth									
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	
AZ Cont. 2 nd Radar										Elevation																				BS
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	
Range (Yards)																										OT	Q	Site ID		
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	
Site 2 nd Radar					WSMR Sync										Sync Code															
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	

Figure 14. IRIG 240-Bit (Two Radar, NASA) Format 3.

Format 3A
IRIG 240-Bit Two Raw Data Radar Format (RAE)

This format is used for the transmission of shuttle landing data from WSMR to 45 SW (see figure 15).

It differs from Format 3 due to a variation in the following characteristics:

LSB weights:

Range 1.7859375 meters

Tenth				Time 1 st Radar (Seconds)																		Azimuth									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
AZ Cont. 1 st (Radar)										Elevation 1 st Radar																				BS	
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60		
Range (Yards)																										OT	Q	Site ID			
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90		
Site 1 st Radar						WSMR Sync						Day of Year						Format Type				Spare									
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120		
Tenth				Time 2 nd Radar (seconds)																		Azimuth									
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150		
AZ Cont. 2 nd Radar										Elevation																				BS	
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180		
Range (Meters)																										OT	Q	Site ID			
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210		
Site 2 nd Radar						WSMR Sync						Sync Code																			
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240		

Figure 15. IRIG 240-Bit (Two Radar, ETR) Format 3A.

Format 4
IRIG 240-Bit Two Data Point Frame Format (RAE)

This format is used for transmitting and receiving data between AFFTC and NASA, between AFFTC and NAWCWD (China Lake), and between AFFTC and UTTR (see figure 16).

Word 1

Bits 1-9	Cycle Error Code: relate to previous frame
Bits 10-16	Frame Sync 1110010 and 0001101: code
Bits 17-23	Site Address
Bits 24-26	On-Track Mode - 1 (OTC-1)
	000 = manual 100 = auto-beacon
	001 = acquisition 101 = error
	010 = coast 110 = tiltmeter-slew
	(UTTR 110 = TV track)
	011 = auto-skin 111 = tiltmeter-static (UTTR 111 = calcs)
Bits 27-30	Aux-1:
	Bit 27 1 = data polar coordinates
	0 = data Cartesian coordinates
	Polaris - range/azimuth/elevation
	Cartesian - X1 (East)/Y1 (North)/Z1 (up)
	Bits 28-29 00 = no refraction/no modeling
	01 = no modeling/refraction applied
	10 = modeling applied/no refraction
	11 = modeling applied/refraction applied
	Bit 30 1 = tone-on 0 = tone-off

Word 2

Bits 31-48	<p>Aux-2: range rate</p> <p>If the radar produces range rate data, that data (16 bits sig magnitude LSB at Bits 31 or 151, LSB = 1/32 yd/sec) shall be present in Aux-2 & Aux-4 only when the on-track word has a value from 0 to 5.</p>
Bits 49-60	<p>Range (binary)</p> <p>LSB = Bit 49 = 1 ft (UTTR LSB = Bit 49 = 1 yd)</p> <p>X1 (East)</p>

Word 3

Bits 61-72	Range (cont.)
Bits 73-90	Azimuth (BAMS), MSB = 180 degrees = Bit 96
	LSB = Bit 73 = 1 ft
	Y1 (North)

Word 4

Bits 91-96	Azimuth (cont.)
Bits 97-120	Elevation (BAMS), MSB = 180 degrees = Bit 120 LSB = Bit 97
	Z1 (up)

Word 5		
	Bits 121-123	OTC-2 On-Track Mode for second sample (1,2,...modes).
	Bits 124-133	Milliseconds Bit 124 LSB = 1 msec Bit 126 LSB = 4 msec
	Bits 134-150	TOD: Time of Day LSB = 1 sec (binary) = Bit 134
Word 6		The fields are the same as for Word 2 except for sample 2.
Word 7		The fields are the same as for Word 3 except for sample 2.
Word 8		The fields are the same as for Word 4 except for sample 2.

NOTE

When data is transmitted to UTTR specifically, the localization is given by Cartesian coordinates. Therefore, the range, azimuth, and elevation fields are changed to x, y, and z fields, respectively.

Where x, y, and z: LSB = 1 foot

x2, y2, and z2: Later update of x, y, and z

x, y, and z: To be in sign magnitude data

MSB is sign bit: 0 = + 1 = -

Polar/Cartesian data: The first sample of the data frame shall be sampled at the time indicated by the milliseconds and time of day. The second sample shall be 50 milliseconds later. The entire frame of data shall be delayed by 100 milliseconds.

Error Code									Frame Sync								Site Address						OTC-1				Aux-1			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Aux-2																	Range (Yards)/X1 (East)													
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
Range (cont.)											Azimuth/1Y1 (North)																			
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	
Azimuth (cont.)						Elevation/Z1 (Up)																								
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	
OTC-2			Milliseconds										Time of Day																	
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	
Aux-4																	Range 2 nd Radar/X2 (East)													
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	
Range (cont.)											Azimuth 2 nd Radar/Y2 (North)																			
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	
Azimuth (cont.)						Elevation 2 nd Radar/Z2 (Up)																								
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	

Figure 16. IRIG 240-Bit (Two Data Point Frame, AFFTC) Format 4.

Format 4A
IRIG 240-Bit Format (RAE)

This format is used for the transmission of TSPI data from AFFTC to NAWCWD (China Lake) (see figure 17). Format 4A is the same as Format 4 except for the following:

Word 1

Bits 24-30 Aux-1

Word 5

Bits 121-127 Aux-3
Bits 128-133 Frame Count

Error Code										Frame Sync										Site Address										Aux-1									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30										
Aux-2										Range (Yards)																													
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60										
Range (cont.)										Azimuth																													
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90										
Azimuth (cont.)										Elevation																													
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120										
AUX-3										Frame Count										Time of Day																			
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150										
Aux-4										Range 2 nd Radar (Yards)																													
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180										
Range (cont.)										Azimuth 2 nd Radar																													
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210										
Azimuth (cont.)										Elevation 2 nd Radar																													
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240										

Figure 17. IRIG 240-Bit (Two Data Point Frame, China Lake) Format 4A.

Format 5
IRIG 240-Bit (ARDC) Format (RAE)

This format is used for transmitting and receiving shuttle data between EPG and WSMR (see figure 18).

Word 1	Bits 1-5	Sync Code: 11010 and 00101 It is alternately complemented.
	Bits 6-20	Auxiliary Auxiliary data switches. Bit numbers 18, 19, and 20 may also be used to indicate tracking mode in which Case 18 is manual skin, 19 is auto beacon, and 20 is auto skin.
	Bits 21-30	Range, LSB = Bit 21
Word 2	Bits 31-44	Range (cont.)
	Bits 45-46	Not Used
	Bits 47-60	Azimuth, MSB = 180 degrees = Bit 63
Word 3	Bits 61-63	Azimuth (cont.)
	Bit 64	Not Used
	Bit 65-81	Elevation, MSB = 180 degrees = Bit 81
	Bits 82-90	Site ID, LSB = Bit 82
Word 4	Bits 91-96	Site ID (cont.)
	Bits 97-113	Not Used
	Bits 114-120	Seconds, LSB = Bit 114 = 1 sec
Word 5	Bits 121-130	Seconds (cont.)
	Bits 131-140	Milliseconds, LSB = Bit 131 = 1 msec
	Bits 141-150	Range
Word 6	The fields of Word 6 are the same as for Word 2.	
Word 7	The fields of Word 7 are the same as for Word 3.	
Word 8	Bits 211-216	Site ID, LSB = Bit 211
	Bits 217-240	VS: Additional sync code for Vax radar interface unit.

NOTE

A & E are MSB justified. If the radar source is less than 17 bit angles, the LSB is omitted from the word.

Sync Code					Auxiliary															Range									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Range (cont.)														NU		Azimuth													
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
AZ		NU	Elevation																	Site ID									
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Site ID (cont.)					NU															Seconds									
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Seconds (cont.)										Milliseconds										Range									
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
Range (cont.)														NU		Azimuth													
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
AZ		NU	Elevation																	Site ID									
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
Site ID (cont.)					VS																								
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Figure 18. IRIG 240-Bit (ARDC, EPG) Format 5.

Format 6
IRIG 240-Bit Format (RAE)

This format is used for transmitting and receiving shuttle data between WSMR and EPG (Fort Huachuca, Mt. Lemon, Scott Peak, AZ) (see figure 19).

Word 1	
Bits 1-5	Sync Code: 01010
Bits 6-15	WSMR ID, LSB = Bit 6
Bits 16-30	Arizona ID: Fixed 000000110100001
Word 2	
Bits 31-39	Arizona ID (cont.) 101000000
Bits 40-44	Site Sync 11010/00101
Bits 45-53	Site ID, LSB = Bit 45
Bits 54-55	Not Used
Bit 56	Quality bit
Bit 57 M/S	Manual (1)/Skin mode (2)
Bit 58 A/B	Auto Beacon
Bit 59 A/S	Auto Skin
Bit 60	Range
	LSB = 1 yd = Bit 60
Word 3	
Bits 61-83	Range (cont.)
Bits 84-85	Not Used
Bits 86-90	Azimuth
	MSB = 180 degrees = Bit 90
Word 4	
Bits 91-102	Azimuth (cont.)
Bit 103	Not Used
Bits 104-120	Elevation
	MSB = 180 degrees = Bit 120
Word 5	
Bits 121-125	Synchronization
Bits 126-135	WSMR ID
Bits 136-150	Not Used
Word 6	
Bits 151-152	Not Used
Bits 153-169	MST Time
	LSB = 1 second = Bit 153
Bits 170-179	Time
	LSB=1 millisecond = Bit 170
Bit 180	Range, LSB = Bit 180

Word 7

Bits 181-203 Range (cont.)
 Bits 204-206 Not Used
 Bits 207-210 Azimuth, MSB = 180 degrees = Bit 222

Word 8

Bits 211-222 Azimuth (cont.)
 Bit 223 Not Used
 Bits 224-240 Elevation, MSB = 180 degrees = Bit 240

Sync Code					WSMR ID										Arizona ID (Fixed)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Arizona ID (cont.)									Site Sync					Site ID							NU	Q	MS	AB	AS	R			
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Range (Yards)																							NU		Azimuth				
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Azimuth (cont.)												NU	Elevation																
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Sync					WSMR ID										Not Used														
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
NU		MST Time L-1.0 Sec																	Time L-1.0 MS							R			
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Range (cont.)																							NU		Azimuth				
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
AZ (cont.)												NU	Elevation																
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Figure 19. IRIG 240-Bit Format 6.

Format 7
IRIG 448-Bit (AWC) Format (XYZ)

This format is used for transmission from AWC Tyndall to AAC. The Tyndall Data System is formatted as a header of three 32-bit words followed by up to 20 target data blocks. Each target data block consists of eleven 32-bit data words. The buffer may therefore vary in length from three to 223 long words depending on how many target data blocks are included. Bit 1 is LSB for all words (see figure 20).

Word 1	Total # of 32-bit words in buffer (includes itself)
Word 2	Item Count
	Number of targets data block
Word 3	Status
	Status word (Bits 28-24 are set by SOS POP-11 on input)
Bits 32-30	Not Used
Bit 29	1 = short buffer
Bit 28	1 = invalid word count
Bit 27	1 = insufficient
Bit 26	1 = data overrun error
Bit 25	1 = microwave parity error
Bits 24-23	Not Used
Bits 22-21	Mission Status
	0 = not def 2 = simulated GRDCS data
	1 = live GRDCS data 3 = end of mission

Data block format is as follows (real time data system/characteristics):

Word 1	GRDCS name
Word 2	Record Number (tall number)
Word 3	Time Stamp (time tag for data, milliseconds, past midnight)
Word 4	X-Position: target x-pos, feet
Word 5	Y-Position: target y-pos, feet
Word 6	Z-Position: target z-pos, feet
Word 7	X-Velocity: target x-vel, feet/sec
Word 8	Y-Velocity: target y-vel, feet/sec
Word 9	Z-Velocity: target z-vel., feet/sec
Word 10	Quality

Word 11

Bits 16-8

Bit 7

Bits 6-4

Bit 3

Bits 2-1

FIT Status

Downlinked FIT status word in lower 16 bits: upper 16 bits are zero. If target is not a FIT, entire word is zero.

FIT address

1 = error

Battery voltage

0 = safe separation

1 = safe

2 = pre-arm

3 = arm

4 = fire

Total # of Words																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Item Count																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Status																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

GRDCS																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Record Number																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Time Stamp																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
X-Position																															
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	

Figure 20. IRIG 448-Bit (AWC, Tyndall) Format 7.

Y-Position																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Z-Position																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
X-Velocity																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Y-Velocity																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Z-Velocity																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
GRDCS Navigation Quality																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
FIT Status																															
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

Figure 20. IRIG 448-Bit (AWC, Tyndall) Format 7 (cont.).

Format 8
IRIG 240-Bit (MDDF) Format (RAE)

This format is used for transmission of shuttle data from NASA radars to 45 SW (see figure 21).

Word 1			
Bits 1-13	SIC (binary)		
Bits 14-17	Vehicle ID		
Bits 18-26	Day of Year (binary), LSB = Bit 18		
Bits 27-30	Format Type: 1110		
Word 2			
Bits 31-51	Time of Day (binary), LSB = Bit 31		
Bits 52-60	Site ID, LSB = Bit 52		
Word 3			
Bits 61-79	Azimuth: MSB = 180 degrees = Bit 79		
Bits 80-90	Elevation: MSB = 180 degrees = Bit 98		
Word 4			
Bits 91-98	Elevation (cont.)		
Bits 99-120	Range: LSB = 1.7859376 meters = Bit 99		
Word 5			
Bits 121-123	Range (cont.)		
Bits 124-150	Doppler (counts of 240 MHz + 1000 fd)		
	LSB = 1 cycle = Bit 124		
Bits 151-171	Doppler (cont.)		
Bits 172-173	One-, Two- or Three-Way Data:		
	00 = 1-way	01 = 2-way	11 = 3-way
Bit 174 (R/T)	Real/Test		
	1 = real data		
Bits 175-176	Geo (antenna geometry):		
	00 = AZ-EL		
	01 = (X-Y) (+X = South)		
	11 = (X-Y) (+X = East)		
Bits 177-180	Spares		
Word 6			
Bit 181 (L)	1 = Liftoff has occurred		
Bit 182 (P)	1 = Plunge		
Bits 183-184	(P/W) Pulse Width		
	00 = 1.0 microsec		
	01 = 2.4 microsec		
	10 = 5.0 microsec		
	11 = 10.0 microsec		
Bit 185 (RI)	Refraction Correction		
	0 = out	1 = in	
Bit 186 (DI)	Droop		
	0 = out	1 = in	

Bit 187 (PO)	Paramp	
	0 = off	1 = on
Bit 188 (RO)	Radiation	
	0 = off	1 = on
Bit 189 (LO)	0 = single lo	1 = dual lo
Bit 190 (B/S)	Beacon/Skin	
	0 = skin	1 = beacon
Bit 191 (T)	Track	
	0 = off	1 = on
Bit 192 (Q)	Quality	
	0 = bad	1 = good
Bits 193-195	Mode	
	000 = manual	100 = on-axis powered flight
	001 = autotrack	101 = on-axis coast
	010 = computer drive	110 = autocoast
	011 = on-axis orbital	
Bit 196 (R)	Range	
	1 = range good	0 = range bad
Bit 197 (A)	Angle	
	1 = angles good	0 = angles bad
Bit 198 (DP)	Dop (Doppler)	
	1 = Doppler good	0 = Doppler bad
Bit 199 (DD)	Destruct Doppler	
	1 = destruct	
Bit 200 (LFI)	Last Frame Indicator	
	1 = last frame	
Bits 201-210	Polynomial Error Code, LSB = Bit 201	
Word 8		
Bits 211-224	Polynomial (cont.)	
Bits 225-240	Synchronization Bits (Bits 240-225) will have the following pattern: 0001101000011010	

Satellite ID Code													Vehicle ID				Day of Year										Format Type												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30										
Time of Day (Seconds)																				Site ID																			
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60										
Azimuth																	Elevation																						
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90										
Elevation (cont.)								Range (Yards)																															
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120										
Range			Doppler (240 MHz + 1000 fd) – 1 Cycle																																				
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150										
Doppler (cont.)																				1-2-3		$\frac{R}{T}$	GEO		Spares														
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180										
L	P	PW		RI	DI	PO	RO	LO	BS	T	Q	Mode		R	A	DP	DD	LFI	Polynomial Error Code																				
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210										
Polynomial (cont.)													Sync Bits																										
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240										

Figure 21. IRIG 240-Bit (MDDF, NASA) Format 8.

Format 9 IRIG 1200-Bit (Space Shuttle) Format (RAE or EFG)

Format 9 is a 1200-bit RTCS/JCS multiplexed tracking data format used between 45 SW (ETR) and NASA. This 1200-bit message is transmitted 6 times per second on a 7.2-kbps line (see figure 22).

Least significant bit weights:

EFG	1 meter (two's complement representation)
EFG	1 meter/second (two's complement rep.)
AZ, EL	1.19842249053566 radians
Range	1.7859375 meters
Position scale codes	(Always zero for RAE data) 00 = do not scale EFG 01 = multiply EFG by 10 10 = multiply EFG by 10^{**3} 11 = multiply EFG by 10^{**10}
Velocity scale factor	(Always zero for RAE data) 00 = do not scale EFG 01 = multiply EFG by 10
Format type codes	1000 - Line 1 0110 - Line 2
Source codes	1000 - Best source smoothed vector (EFG) 0100 - Limited best source raw (RAE) 0010 - Limited second best source raw (RAE) 1111 - Null (data slot contents are zero filled)
Data type codes	1000 - Real data 0100 - Test data 0010 - Simulated data 1111 - Null (data slot contents are zero filled)
Status bits**	
Mode	0 = manual 1 = auto track 2 = computer drive 3 = on-axis orbital 4 = on-axis powered flight 5 = on-axis coast 6 = auto-track coast
Quality (Q)	1 = good 0 = bad
Track **	1 = on 0 = off
Beacon/Skin	1 = beacon 0 = skin
Lo **	1 = dual 0 = single

Radiation (R) **

1 = on 0 = off

PAVAMP (P) **

1 = on 0 = off

DROOP (D) **

1 = in 0 = out

Refraction (REF)

1 = in 0 = out

Pulse Width (PW) **

00 = 1.0 ms 10 = 5.0 ms
01 = 2.4 ms 11 = 10.0 ms

Plunge Mode (PL) **

1 = plunge 0 = normal

Liftoff (LO) **

1 = occurred 0 = not occurred

** N/A to JSC data. Set to zero.

Error Protection																													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Bit Sync Code																		For. Type			Source Code			Data Type					
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Spare				Object/Test																Day of Year									
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Null				Tenths Time (Seconds)											Site ID								E or Range						
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
E or Range (cont.)																													
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
S	Pos.	F or Azimuth																											
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
S	Vel.	G or Elevation																											
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
S	Null	F or Null																E or Null											
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Data Block 1 Begins at Bit 49

Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9.

ELE (cont.)				LO	PL	PW		R	D	P	R	LO	BS	T	Q	Mode			G or Null												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
S				Check Sum								Spare							Sync.												
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60		
Sync.				For. Type				Source C				Data Type				Spare				Object/Test											
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90		
Obj. (cont.)								Day of Year								Null				Tenth				Time							
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120		
Time (cont.)												Site ID								Range											
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150		
Range (cont.)																Null				Azimuth											
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180		
AZ (cont.)										Null										Elevation											
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210		
EL (cont.)										Null																					
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240		

Data Block 2 Begins at Bit 65

Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9 (cont.).

Null																					LO	PL	PW			R	D	P	R	LO	BS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
T	C	Mode			Null																								Spare		
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60		
Spare				Sync																For. Type				Source C			Data				
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90		
Type	Spare			Null																		Day of Year									
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120		
DOY	Null			Tenth			Time (Seconds)																Site ID								
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150		
Site (cont.)					Range (Meters)																										
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180		
R	Null				Azimuth																		Null								
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210		
Null					Elevation																		Null								
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240		

Data Block 3 Begins at Bit 81

Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9 (cont.).

Null																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Null						LO	PL	PW		R	D	P	R	LO	BS	T	Q	Mode			Null										
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60		
Null						Check Sum						Spare						Synchronization													
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90		
Sync						For. Type				Source C				Data Type				Null				Object/Test									
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120		
Object/Test (cont.)										Day of Year										Null				Tenth				Time			
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150		
Seconds												Site ID										Range									
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180		
Range																Null						Azimuth									
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210		
AZ (cont.)												Null										Elevation									
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240		

Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9 (cont.).

Elevation												Null																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Null																						LO	PL	PW		R	D	P	R
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
LO	BS	T	Q	Mode		Null																Check Sum							
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Spare					Synchronization																Fill (Ones)								
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Fill (Ones)																													
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
Fill (Ones)																													
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Fill (Ones)																													
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
Fill (Ones)										Block ID			Synchronization																
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Data Block 4 Ends at Bit 112

Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9 (cont.).